2.4 Practice - Linear Models

1. In 1980, the Wincom River was 32 feet below the bridge. Because of silt build-up in the river bottom, the river was only 14 feet below the bridge by 1989.

a) Write an equation for the distance of the river from the bridge, *d*, with *t* = 0 representing 1980.

b) What is the meaning of the slope in this equation?

c) If nothing is done about the silt, what year will the river reach the bridge?

2. In 1988, the average price of a home in Brainerd County was $91,000. By 1995 the average price of a home was $119,000.

a) Write an equation for the price of a home, *P*, in Brainerd County *t* years after 1988.

b) What is the meaning of the slope?

c) What was the average price of a home in 2000?

d) According to the model, when will the average price of homes in Brainerd County reach $275,000?

3. A rental car costs $65 per day plus a fixed charge for each mile driven. One customer paid $93 for driving 140 miles.

a) Write an equation for the cost of the rental, *C*, in terms of the number of miles driven, *m*.

b) What is the meaning of the slope?

c) How much will the rental cost be if the customer drives 50 miles?

d) If a customer wants to keep the rental fee under $100, what is the maximum number of miles he can drive?

4. Mrs. Toomey went to Costco and bought 3 packages of lawn refuse bags, each package containing 25 bags. On average, she and her husband use 3 per week to pick up grass clippings and leaves.

a) Write an equation for the number of lawn bags, *b*, **remaining** after *w* weeks.

b) When will Mrs. Toomey run out of lawn refuse bags and have to buy more?

c) Graph the situation. Label completely.

d) Identify the domain of this situation.

e) Identify the range of this situation.

5. The speeding fine for driving 10 miles over the speed limit is $150 and the fine for driving 20 miles per hour too fast is $250.

a) Write a model for the situation.

b) Clearly define your independent variable.

c) Clearly define your dependent variable.

d) What is the meaning of the slope?

e) What is the fine for driving 20 mph over the speed limit?

f) How fast do you have to be going to be fined $500?

6. A company finds their production cost for 10 solar heaters is $7500 and $13900 for 20 heaters.

a) Write a model for this situation.

b) Clearly define your independent variable.

c) Clearly define your dependent variable.

d) What is the meaning of the slope?

e) How much will it cost the company to produce 100 heaters?

f) The company is trying to keep costs under $50,000. How many heaters can they make?

7. At F, a certain species of cricket chirps 24 times per minute. At F, the same cricket chirps 86 times per minute.

a) Write a model for this situation.

b) Clearly define your independent variable.

c) Clearly define your dependent variable.

d) What is the meaning of the slope?

e) How many times would the cricket chirp if the temperature were F?

f) What would the temperature be if the cricket were chirping 50 times per minute?

g) How cold would it have to be for the cricket to stop chirping?

h)What is the domain of this situation?

i) What is the range of the situation?

j) Graph the situation. Label completely.

8. In 1990, a home was purchased for $120,000. In 2000 it was appraised for $146,000.

a) Write an equation to model the value of the house *t* years after 1990.

b) What is the meaning of the slope?

c) According to the model, how much will the house appraise for today?

9. A company has a packaging machine that costs $3500 per year plus $2.32 per unit packaged. Express the total yearly cost of operating this machine in terms of the number of units packaged. Use c and u as the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. What is the c-intercept and what does it mean?
6. What will be the cost of operating this machine if it packages 250 units during the year?
7. If the company wants to keep the yearly operating cost of this machine under $10,000, how many units should this machine package?

10. Mr. McCollum’s swimming pool holds 100,000 gallons of water. This pool has a drain system, which is capable of removing water at a rate of 20 gallons per minute. Suppose that the pool is full and then the drain is opened. Use g and t as the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. How many gallons of water are in the pool 2 ½ hours after the drain is opened, if the pool was full when the drain was first opened?
6. How long after the drain is opened in the full pool will it take until the pool contains only 50,000 gallons of water?
7. How long after the drain is opened in the full pool will it take until the pool is empty?
8. Domain?
9. Range?
10. Sketch a graph of this function.
11. What is the g-intercept and what does it mean?
12. What is the t-intercept and what does it mean?

11. A particular brand of algaecide for use in small swimming pools recommends that 1 oz of algaecide be used for every 75 gallons of water in the pool. Use g and a as the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. If a family using the recommended dose put 12 ¼ oz of algaecide in a children’s wading pool, how many gallons of water did the pool contain?
6. If a child’s swimming pool contains 110 gallons of water, what is the recommended dose of algaecide?

12. Wholly-Cow sells one gallon (4 quarts) of milk for $3.09 each and half-gallon cartons for $1.65 each. Assume that the number of cents you pay for a carton of milk varies linearly with the number of quarts the carton holds. Use c and q as the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. If Wholly-Cow sold 3-gallon cartons, what would your equation predict the price to be?
6. Suppose that you found cartons of milk priced at $3.45, but there was nothing on the label to indicate the size of the carton. How much milk should this carton hold, according to your model?
7. Sketch the graph of the function. Label your axes carefully.
8. What does the price-intercept represent in the real world?

13. Suppose your family is going to purchase a new air conditioning unit for the lake house. EZCool costs $900 to purchase and $30 a month to operate. Polar-aire costs $1300 to purchase and $25 a month to operate. Let x=number of months the unit is operated. Let f(x)=the number of dollars spent in x months for EZCool. Let g(x)=the number of dollars spent in x months for Polar-aire.

1. f (x)=
2. g (x)=
3. Find the cost for each unit after 30 months. What do these numbers tell us?
4. Find the cost for each unit after 100 months. What do these numbers tell us?
5. Graph these functions below using the points found in the previous two questions. Label your axes carefully.

14. You run warm water into a pitcher and then cool it down by adding ice cubes. You find that putting in 5 cubes cools the water to 66oC, and 15 cubes cools the water to 43 oC. Use c and t as the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. What is the t-intercept? What does it mean?
6. What is the c-intercept? What does it mean? Is it reasonable? Why or why not?
7. What total number of cubes would have to be put in to reduce the water temperature to freezing (32 oF)?
8. Predict the temperature of the water if you put in 10 cubes.
9. Sketch the function. Make sure you alter the end behavior to model what happens in the real world.

15. A professor at a large university gave a test in her College Algebra course. After the tests were graded, she decided to scale the grades (what a fairy tale this is turning out to be!). Since the highest grade was 93, she wanted to convert it to a scaled grade of 100. She decided that those papers that had scores of 45 or better demonstrated sufficient knowledge of the subject to receive a passing grade, so she wanted this 45 to convert to a 60. A linear relationship seemed reasonable. Use f (first score) and s (scaled score) for the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. What scaled score would be assigned to a paper that originally earned a 56?
6. If a paper received a scaled score of 87.5, what was its original score?
7. What is an appropriate domain for this situation?
8. What is the s-intercept? What does it mean?
9. What is the f-intercept? What does it mean?
10. If the instructor regards scaled scores in the interval [80,90) to have earned a grade of B. In what interval would the original grades fall to eventually correspond to a B?
11. Graph this function. Label the axes carefully.

16. Jack is filling the dunking booth at the state fair. After letting the hose run for 5 minutes, there are 43 gallons of water in the tank and 15 minutes later the water level reaches 103 gallons. Use m and w as the variables.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. What does the w-intercept represent in this situation?
6. How many gallons of water are in the tank one half hour after Jack begins filling it?
7. If the tank reaches its maximum capacity when there are 200 gallons of water in it, how long will Jack have to spend filling the tank?
8. Determine an appropriate domain and range for this situation.
9. Graph this situation. Clearly label your axes.

17. A family bought an air conditioning unit for their home. Using their electric bills from the previous year (when they did not have an air conditioner), they were able to estimate how much money they spent for electricity to run the unit. They also kept a record of all other expenditure, such as filters and service calls. According to their records, after 5 months they had spent a total of $2460 on air conditioning. At the end of the first year, the total cost was up to $2950. They believe the relationship between the number of months since the air conditioner was purchased should be linear.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. Graph this function. Label the axes carefully.

18. The value of an automobile decreases, or depreciates, with time. A student who wanted to buy a new car talked to a car salesman and found that his car, which is 35 months old, had a trade in value of $5770. One year earlier when he had talked to another car salesman about trading in his car, he had been told that his car had a trade in value of $8230. Assume that the dealership was assuming that the car’s value depreciated linearly as a function of time.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. If the student is determined to get another car before the trade in value of his car reaches $2000, how soon must he trade cars?
6. According to your model, how long until his car is worthless?
7. According to your model, what was the car worth when it was new?
8. If the student’s parents paid $15500 for the car when it was new, why is this value different from your answer in the previous question?
9. Sketch a graph of this function. Label your axis.

19. The labor charge on a plumber’s bill depends on the number of hours she spends on the job. After the terrific flood in Macon, a man polled two of his neighbors to figure out how much he might expect his plumbing bill to be. One particular plumber charged $175 for a job that takes 3 ½ hours, and $275 for a 6-hour job. Assume a linear relationship between labor charge and hours spent on the job.

1. Independent variable?
2. Dependent variable?
3. Slope? What does it mean?
4. Equation?
5. How much will a 7-hour job cost?
6. If the customer is charged $205, how long did the plumber spend on the job?
7. What is the labor-fee intercept and what does it mean?
8. Sketch a graph of this function. Label your axis.